FIG. 1

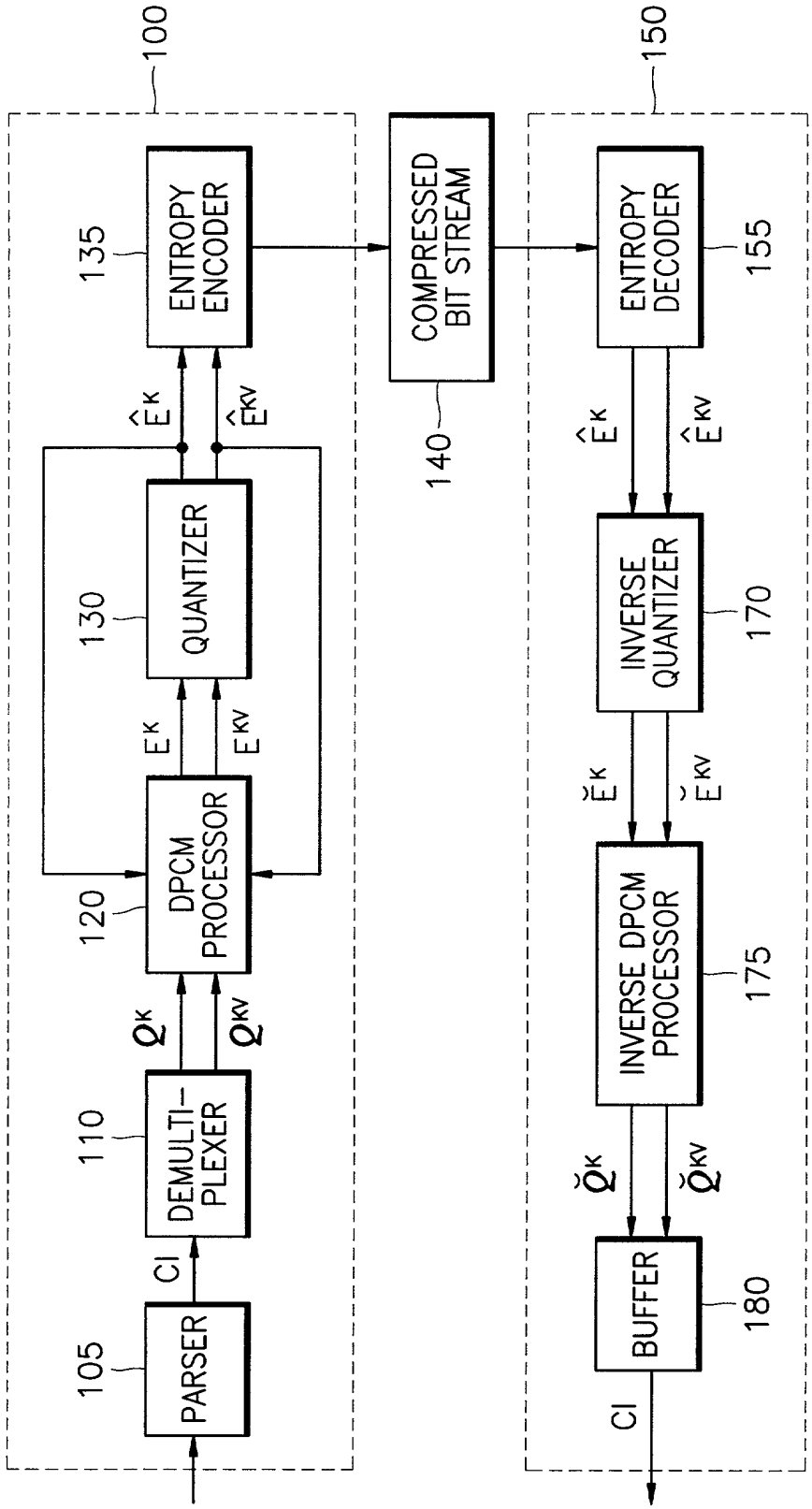

100
150
105
PARSER
CI
110
DEMULTI-PLEXER
Q^K
Q^{KV}
120
DPCM PROCESSOR
E^K
E^{KV}
130
QUANTIZER
$\hat{E}^K$
$\hat{E}^{KV}$
135
ENTROPY ENCODER
140
COMPRESSED BIT STREAM
155
ENTROPY DECODER
$\hat{E}^K$
$\hat{E}^{KV}$
170
INVERSE QUANTIZER
$\check{E}^K$
$\check{E}^{KV}$
175
INVERSE DPCM PROCESSOR
$\check{Q}^K$
$\check{Q}^{KV}$
180
BUFFER
CI

FIG. 2

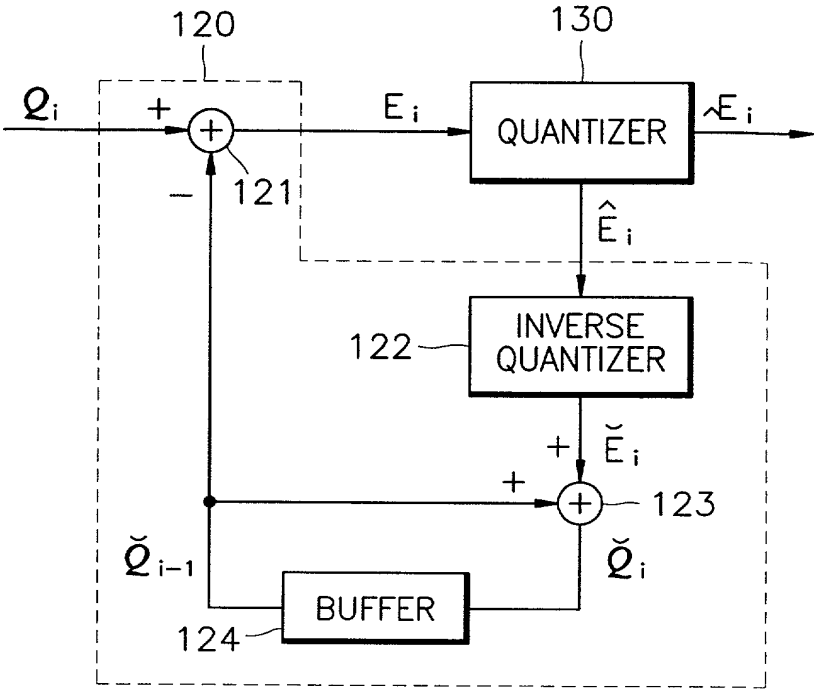

120
130
Q_i
+
E_i
QUANTIZER
$\tilde{E}_i$
121
−
$\hat{E}_i$
122
INVERSE QUANTIZER
+
$\check{E}_i$
+
123
$\check{Q}_{i-1}$
$\check{Q}_i$
BUFFER
124

FIG. 3

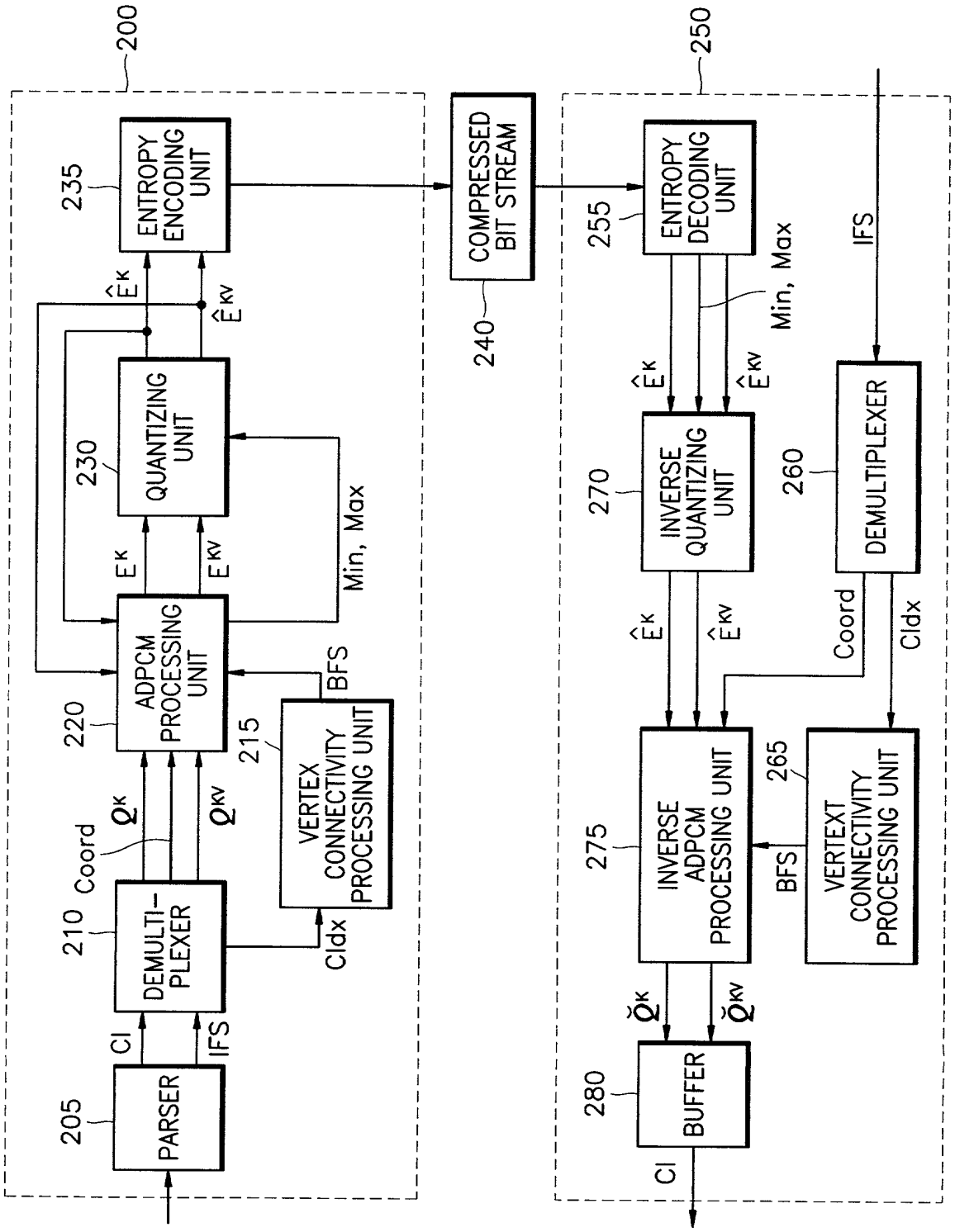

200
250
235
ENTROPY ENCODING UNIT
230
QUANTIZING UNIT
220
ADPCM PROCESSING UNIT
215
VERTEX CONNECTIVITY PROCESSING UNIT
210
DEMULTI-PLEXER
205
PARSER
CI
IFS
Coord
Cldx
BFS
Min, Max
240
COMPRESSED BIT STREAM
255
ENTROPY DECODING UNIT
270
INVERSE QUANTIZING UNIT
260
DEMULTIPLEXER
275
INVERSE ADPCM PROCESSING UNIT
265
VERTEXT CONNECTIVITY PROCESSING UNIT
280
BUFFER

FIG. 4

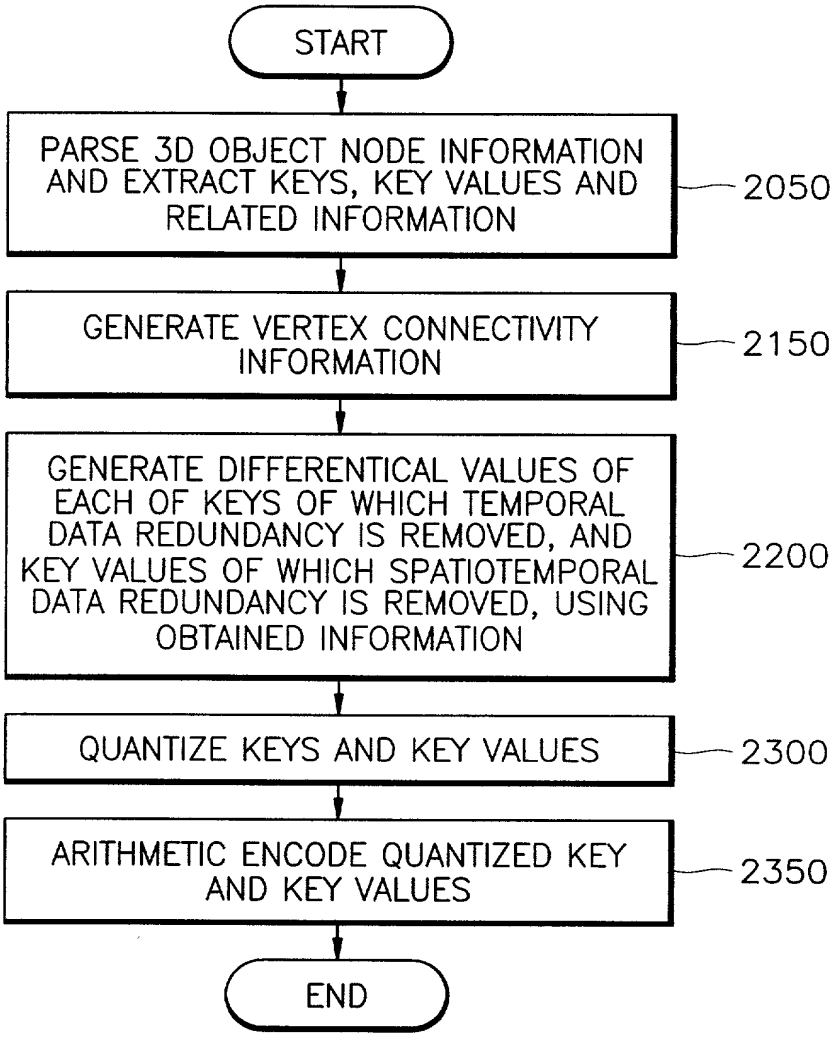

START
PARSE 3D OBJECT NODE INFORMATION AND EXTRACT KEYS, KEY VALUES AND RELATED INFORMATION
2050
GENERATE VERTEX CONNECTIVITY INFORMATION
2150
GENERATE DIFFERENTICAL VALUES OF EACH OF KEYS OF WHICH TEMPORAL DATA REDUNDANCY IS REMOVED, AND KEY VALUES OF WHICH SPATIOTEMPORAL DATA REDUNDANCY IS REMOVED, USING OBTAINED INFORMATION
2200
QUANTIZE KEYS AND KEY VALUES
2300
ARITHMETIC ENCODE QUANTIZED KEY AND KEY VALUES
2350
END

FIG. 5

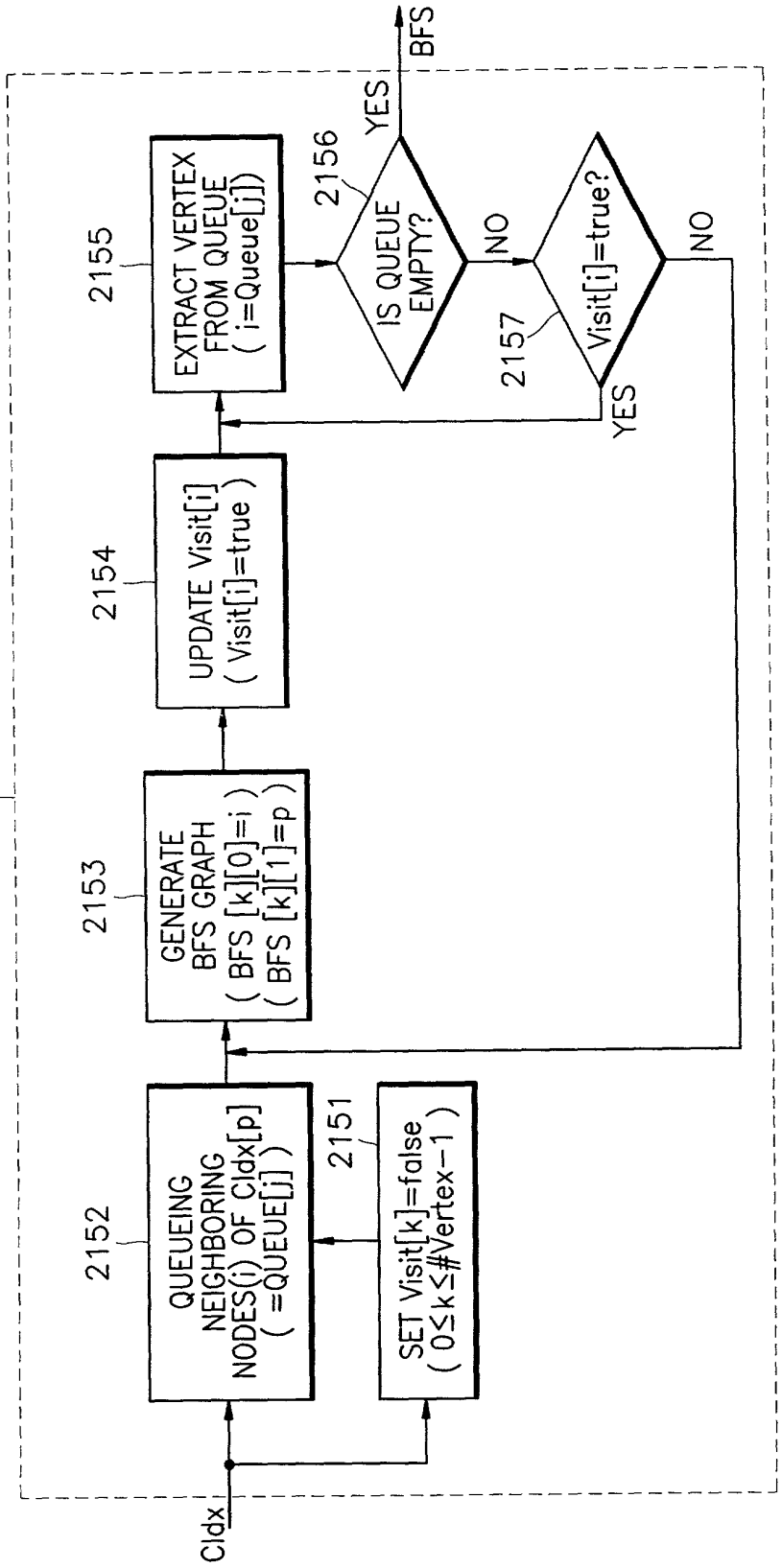

2150
Cldx
2151
SET Visit[k]=false
(0≤k≤#Vertex−1)
2152
QUEUEING
NEIGHBORING
NODES(i) OF Cldx[p]
(=QUEUE[j])
2153
GENERATE
BFS GRAPH
(BFS [k][0]=i)
(BFS [k][1]=p)
2154
UPDATE Visit[i]
(Visit[i]=true)
2155
EXTRACT VERTEX
FROM QUEUE
(i=Queue[j])
2156
IS QUEUE
EMPTY?
YES
BFS
NO
2157
Visit[i]=true?
NO
YES

FIG. 6

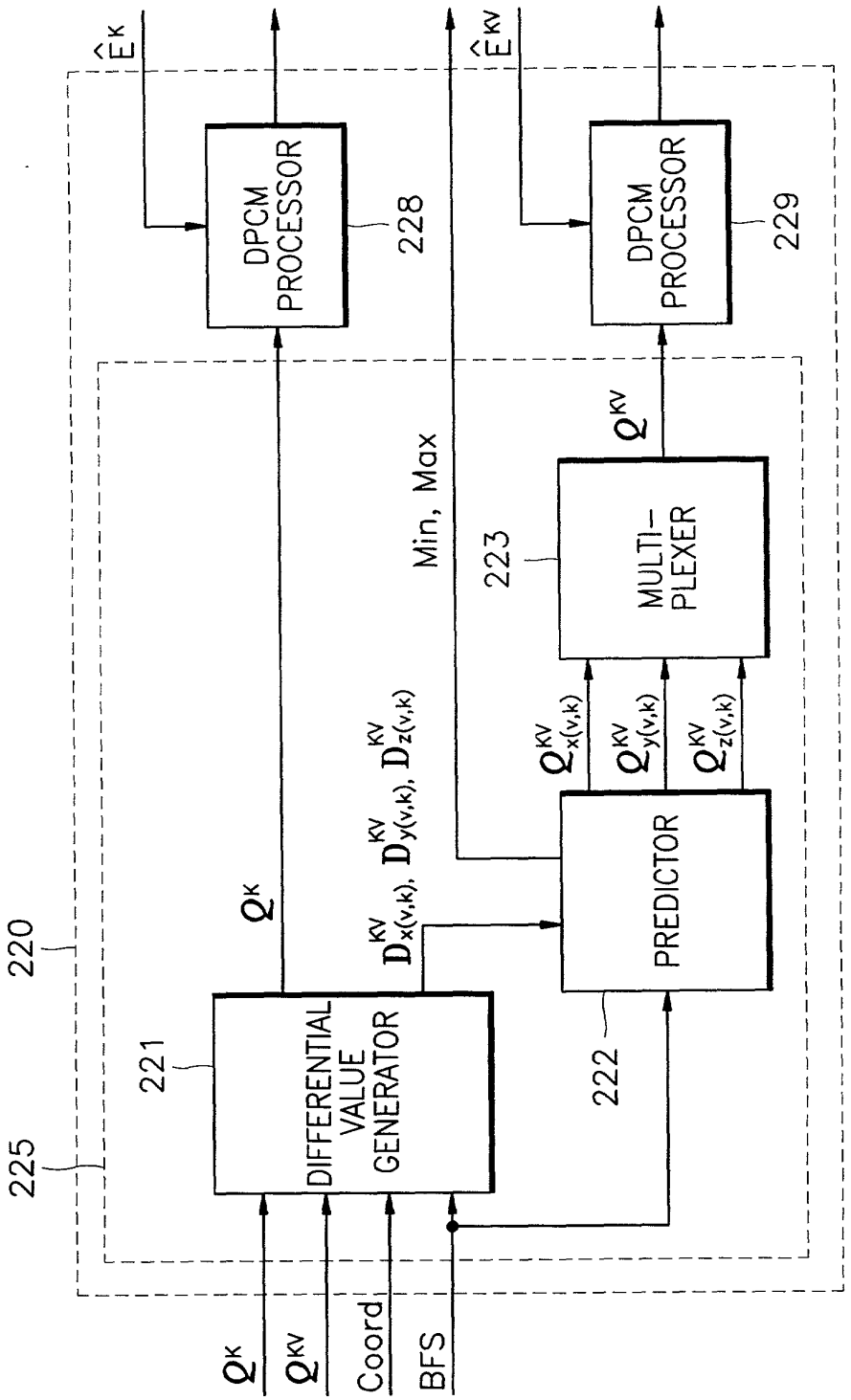

$\hat{E}^K$
$\hat{E}^{KV}$
DPCM PROCESSOR
228
DPCM PROCESSOR
229
Q^{KV}
223
MULTI-PLEXER
Min, Max
Q^K
$D^{KV}_{x(v,k)}$, $D^{KV}_{y(v,k)}$, $D^{KV}_{z(v,k)}$
$Q^{KV}_{x(v,k)}$ $Q^{KV}_{y(v,k)}$ $Q^{KV}_{z(v,k)}$
220
221
DIFFERENTIAL VALUE GENERATOR
PREDICTOR
222
225
Q^K
Q^{KV}
Coord
BFS

FIG. 7

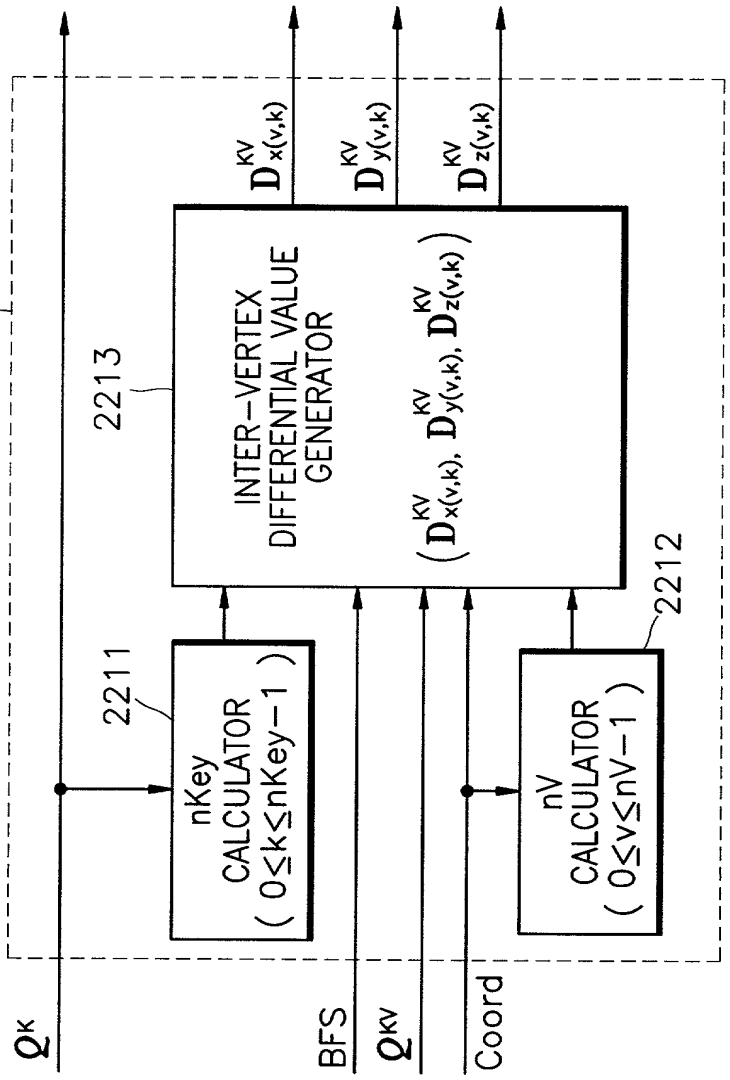

221
2213
INTER-VERTEX DIFFERENTIAL VALUE GENERATOR
$D^{KV}_{x(v,k)}$
$D^{KV}_{y(v,k)}$
$D^{KV}_{z(v,k)}$
$(D^{KV}_{x(v,k)}, D^{KV}_{y(v,k)}, D^{KV}_{z(v,k)})$
2211
nKey CALCULATOR (0≤k≤nKey−1)
2212
nV CALCULATOR (0≤v≤nV−1)
Q^K
BFS
Q^{KV}
Coord

FIG. 8

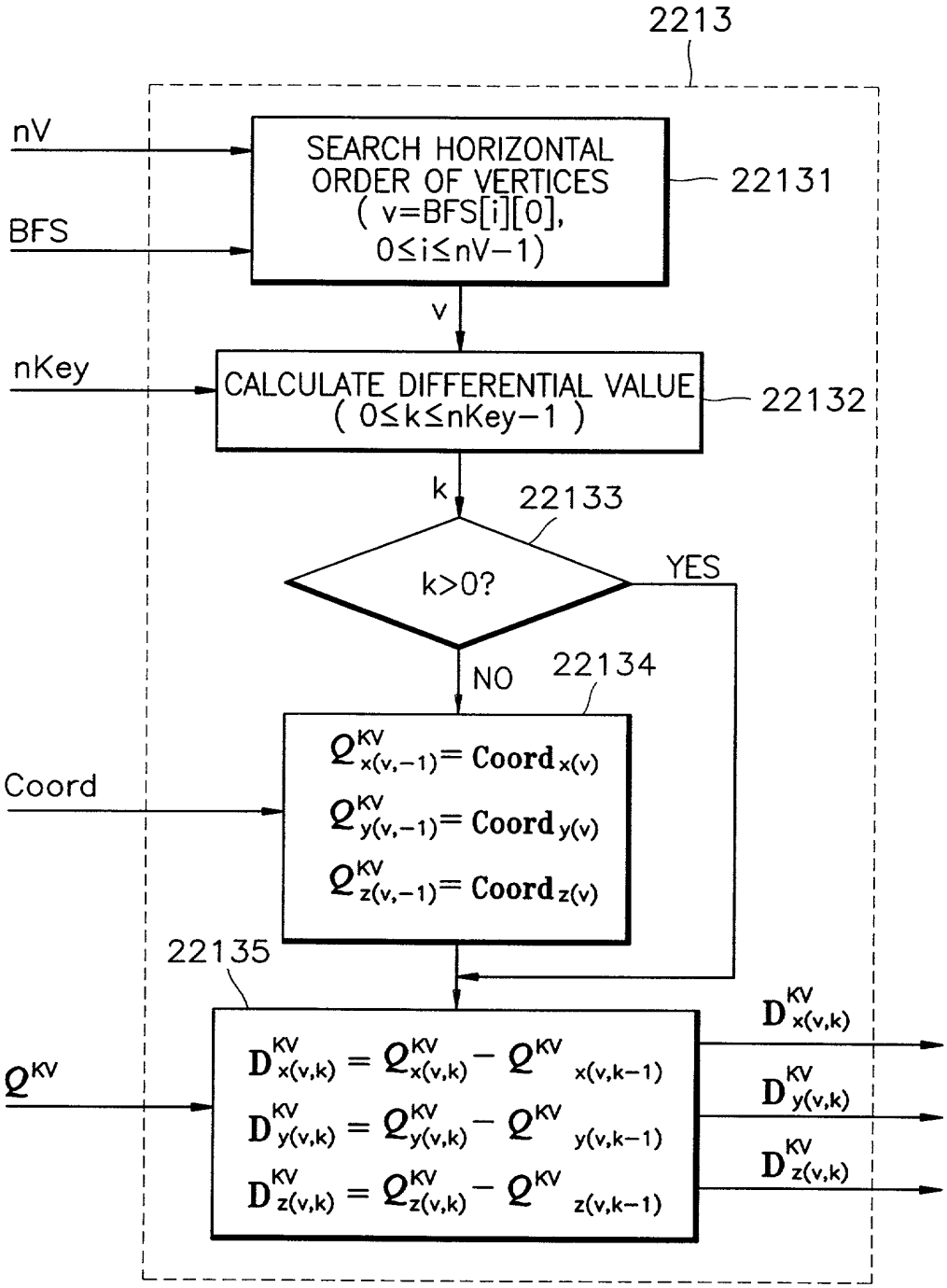

2213
nV
BFS
SEARCH HORIZONTAL ORDER OF VERTICES (v=BFS[i][0], 0≤i≤nV−1)
22131
v
nKey
CALCULATE DIFFERENTIAL VALUE (0≤k≤nKey−1)
22132
k
22133
k>0?
YES
NO
22134
Coord
$Q^{KV}_{x(v,-1)} = Coord_{x(v)}$
$Q^{KV}_{y(v,-1)} = Coord_{y(v)}$
$Q^{KV}_{z(v,-1)} = Coord_{z(v)}$
22135
Q^{KV}
$D^{KV}_{x(v,k)} = Q^{KV}_{x(v,k)} - Q^{KV}_{x(v,k-1)}$
$D^{KV}_{y(v,k)} = Q^{KV}_{y(v,k)} - Q^{KV}_{y(v,k-1)}$
$D^{KV}_{z(v,k)} = Q^{KV}_{z(v,k)} - Q^{KV}_{z(v,k-1)}$
$D^{KV}_{x(v,k)}$
$D^{KV}_{y(v,k)}$
$D^{KV}_{z(v,k)}$

FIG. 9

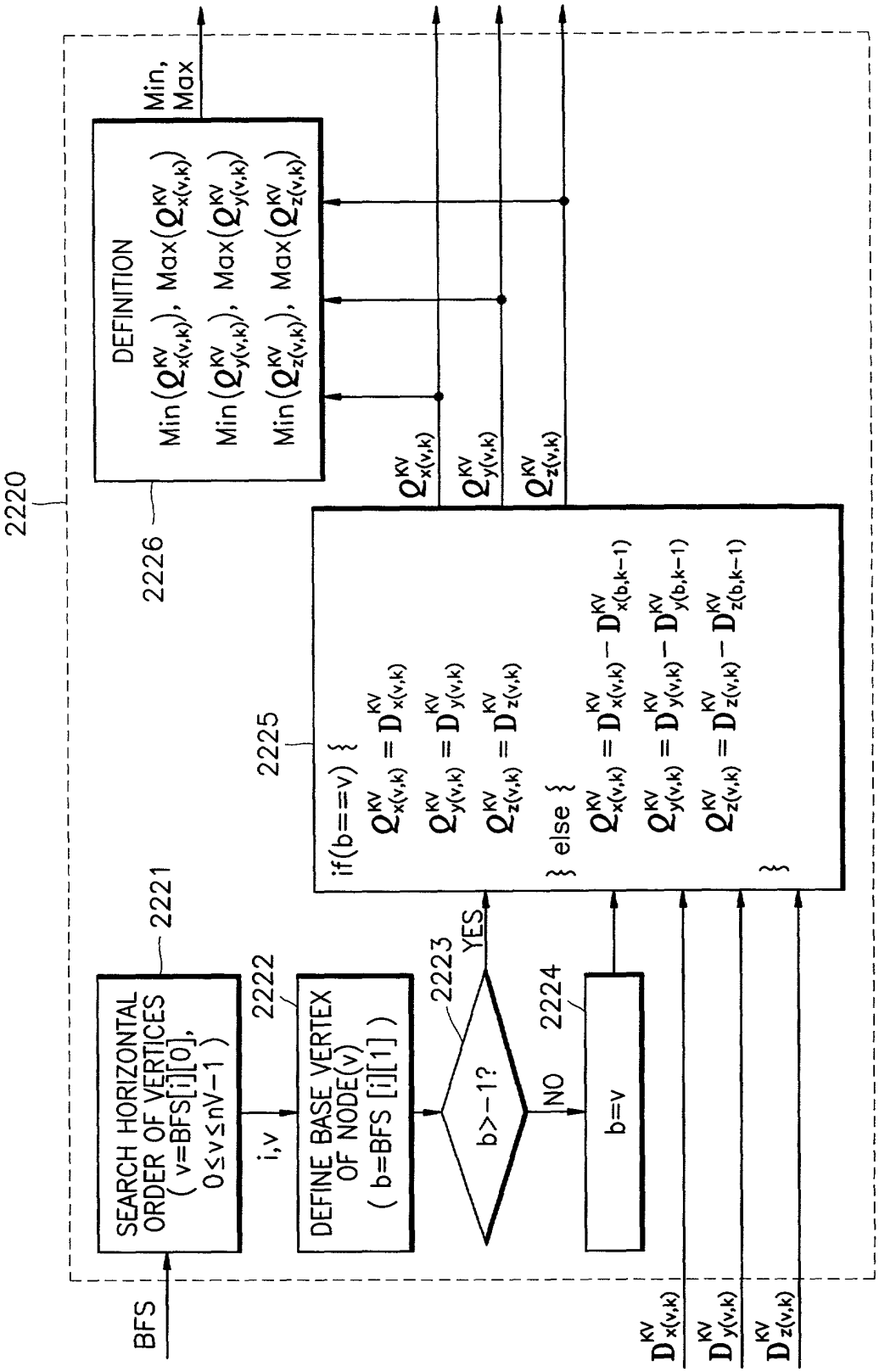

2220
BFS
SEARCH HORIZONTAL ORDER OF VERTICES (v=BFS[i][0], 0≤v≤nV−1)
2221
i,v
DEFINE BASE VERTEX OF NODE(v) (b=BFS [i][1])
2222
b>−1?
2223
YES
NO
b=v
2224
if(b==v) {
$Q^{KV}_{x(v,k)} = D^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)} = D^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)} = D^{KV}_{z(v,k)}$
} else {
$Q^{KV}_{x(v,k)} = D^{KV}_{x(v,k)} - D^{KV}_{x(b,k-1)}$
$Q^{KV}_{y(v,k)} = D^{KV}_{y(v,k)} - D^{KV}_{y(b,k-1)}$
$Q^{KV}_{z(v,k)} = D^{KV}_{z(v,k)} - D^{KV}_{z(b,k-1)}$
}
2225
DEFINITION
$\mathrm{Min}(Q^{KV}_{x(v,k)})$, $\mathrm{Max}(Q^{KV}_{x(v,k)})$
$\mathrm{Min}(Q^{KV}_{y(v,k)})$, $\mathrm{Max}(Q^{KV}_{y(v,k)})$
$\mathrm{Min}(Q^{KV}_{z(v,k)})$, $\mathrm{Max}(Q^{KV}_{z(v,k)})$
2226
Min, Max
$Q^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)}$
$D^{KV}_{x(v,k)}$
$D^{KV}_{y(v,k)}$
$D^{KV}_{z(v,k)}$

FIG. 10

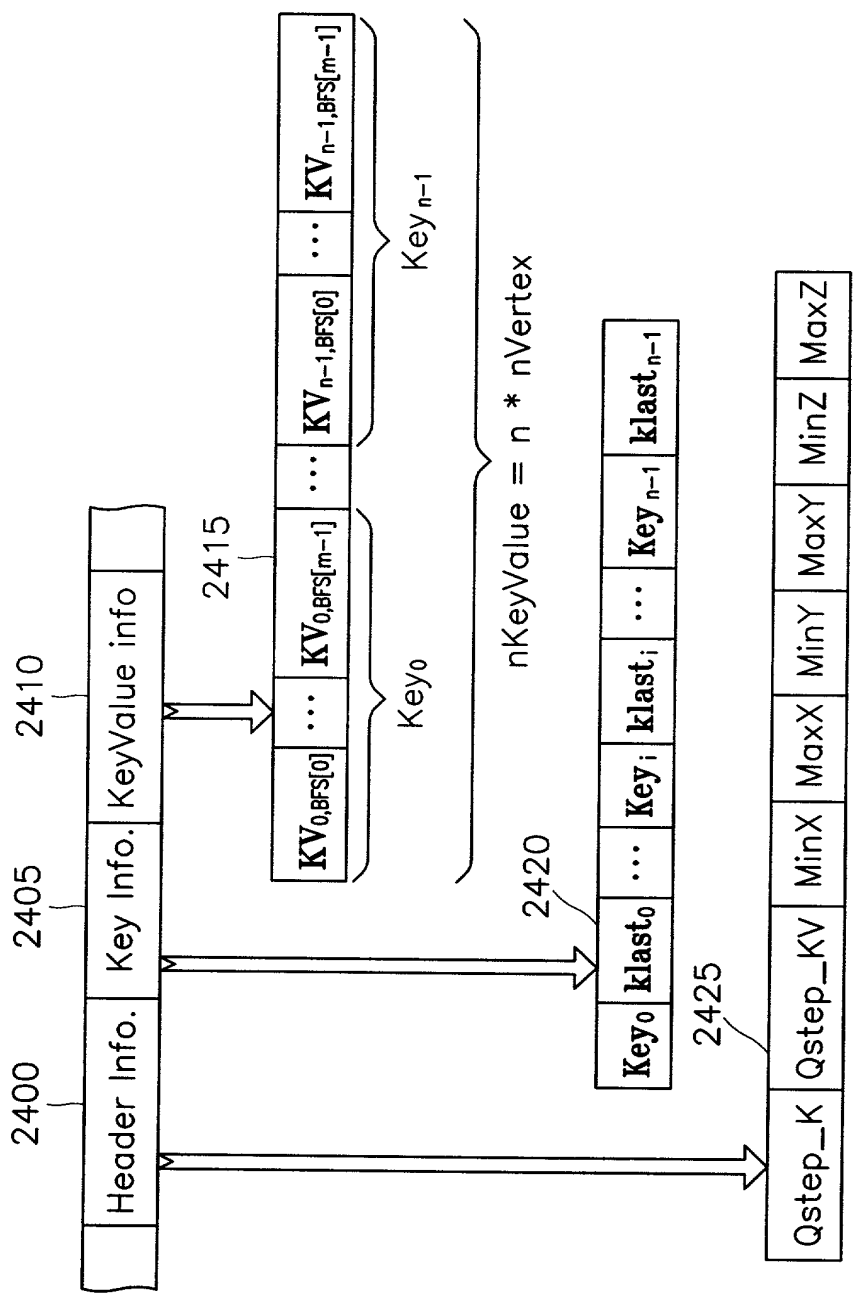

2400
2405
2410
2415
2420
2425
Header Info.
Key Info.
KeyValue info
KV0,BFS[0]
KV0,BFS[m-1]
KVn-1,BFS[0]
KVn-1,BFS[m-1]
Key0
Keyn-1
nKeyValue = n * nVertex
Key0 klast0
Keyi klastj
Keyn-1 klastn-1
Qstep_K
Qstep_KV
MinX
MaxX
MinY
MaxY
MinZ
MaxZ

FIG. 11

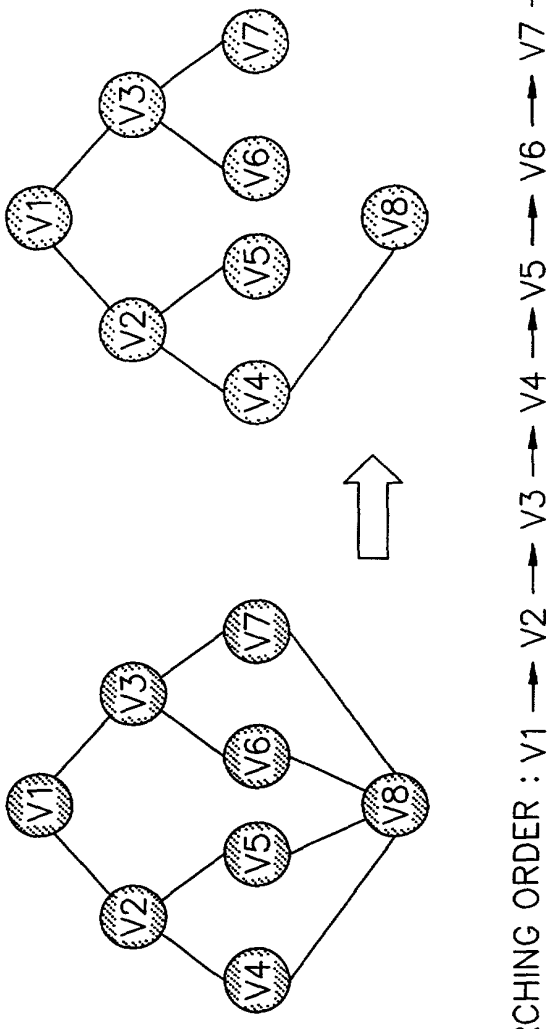

V1
V2
V3
V4
V5
V6
V7
V8
V1
V2
V3
V4
V5
V6
V7
V8
SEARCHING ORDER : V1 → V2 → V3 → V4 → V5 → V6 → V7 → V8

FIG. 12

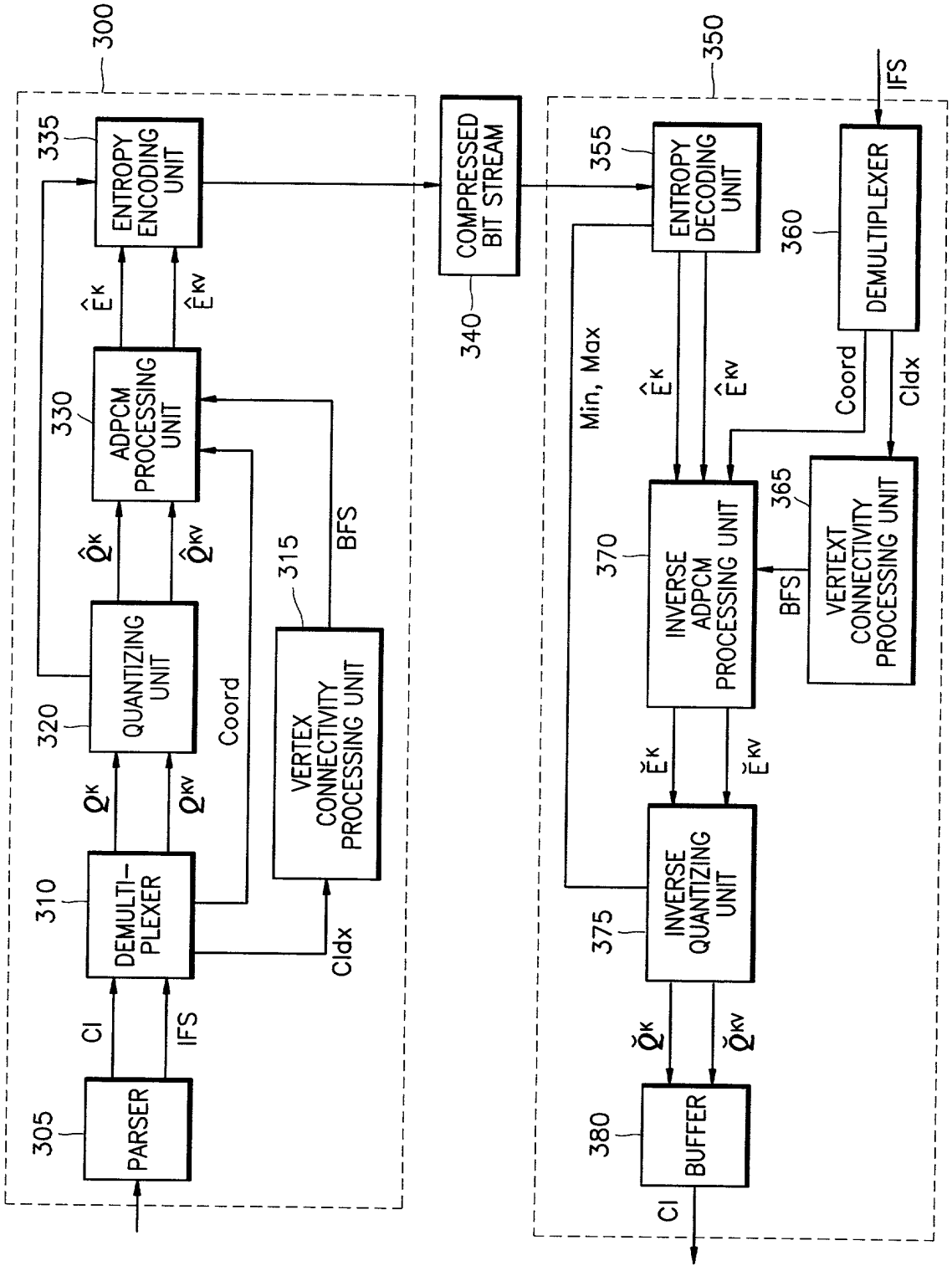

300
305
PARSER
CI
IFS
310
DEMULTI-PLEXER
320
QUANTIZING UNIT
330
ADPCM PROCESSING UNIT
335
ENTROPY ENCODING UNIT
315
VERTEX CONNECTIVITY PROCESSING UNIT
Coord
Cldx
BFS
340
COMPRESSED BIT STREAM
350
355
ENTROPY DECODING UNIT
360
DEMULTIPLEXER
365
VERTEXT CONNECTIVITY PROCESSING UNIT
370
INVERSE ADPCM PROCESSING UNIT
375
INVERSE QUANTIZING UNIT
380
BUFFER
Min, Max

FIG. 13

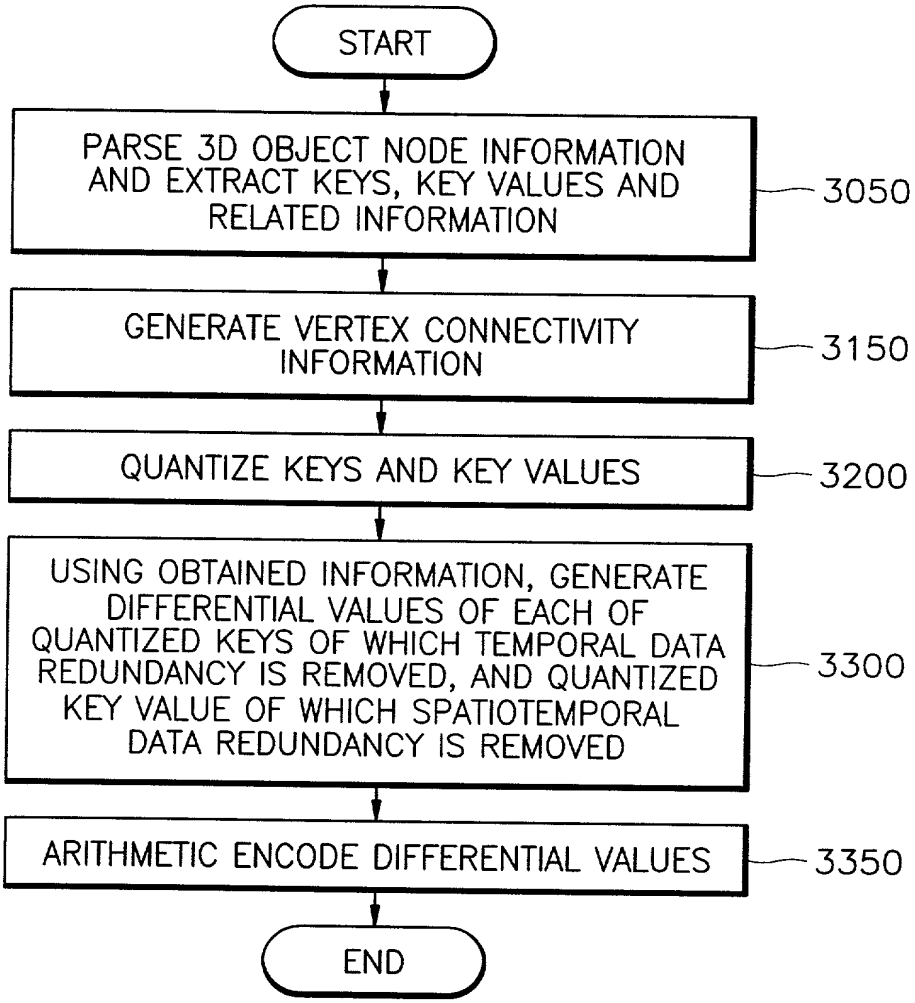

START
PARSE 3D OBJECT NODE INFORMATION AND EXTRACT KEYS, KEY VALUES AND RELATED INFORMATION
3050
GENERATE VERTEX CONNECTIVITY INFORMATION
3150
QUANTIZE KEYS AND KEY VALUES
3200
USING OBTAINED INFORMATION, GENERATE DIFFERENTIAL VALUES OF EACH OF QUANTIZED KEYS OF WHICH TEMPORAL DATA REDUNDANCY IS REMOVED, AND QUANTIZED KEY VALUE OF WHICH SPATIOTEMPORAL DATA REDUNDANCY IS REMOVED
3300
ARITHMETIC ENCODE DIFFERENTIAL VALUES
3350
END

FIG. 14

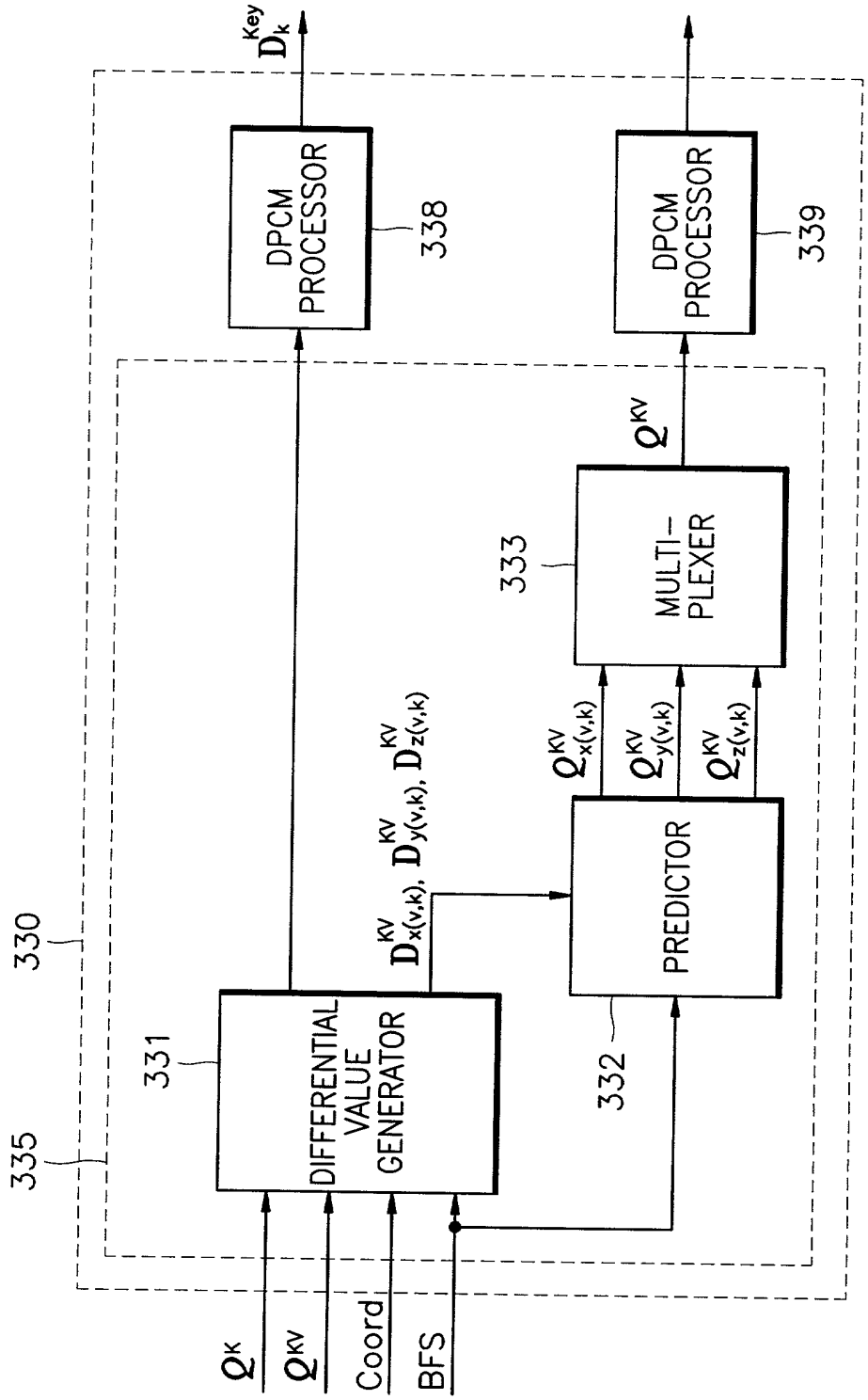

D_k^{Key}
DPCM PROCESSOR
338
DPCM PROCESSOR
339
Q^{KV}
333
MULTI-PLEXER
$Q^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)}$
$D^{KV}_{x(v,k)}$, $D^{KV}_{y(v,k)}$, $D^{KV}_{z(v,k)}$
PREDICTOR
332
330
331
DIFFERENTIAL VALUE GENERATOR
335
Q^K
Q^{KV}
Coord
BFS

FIG. 15

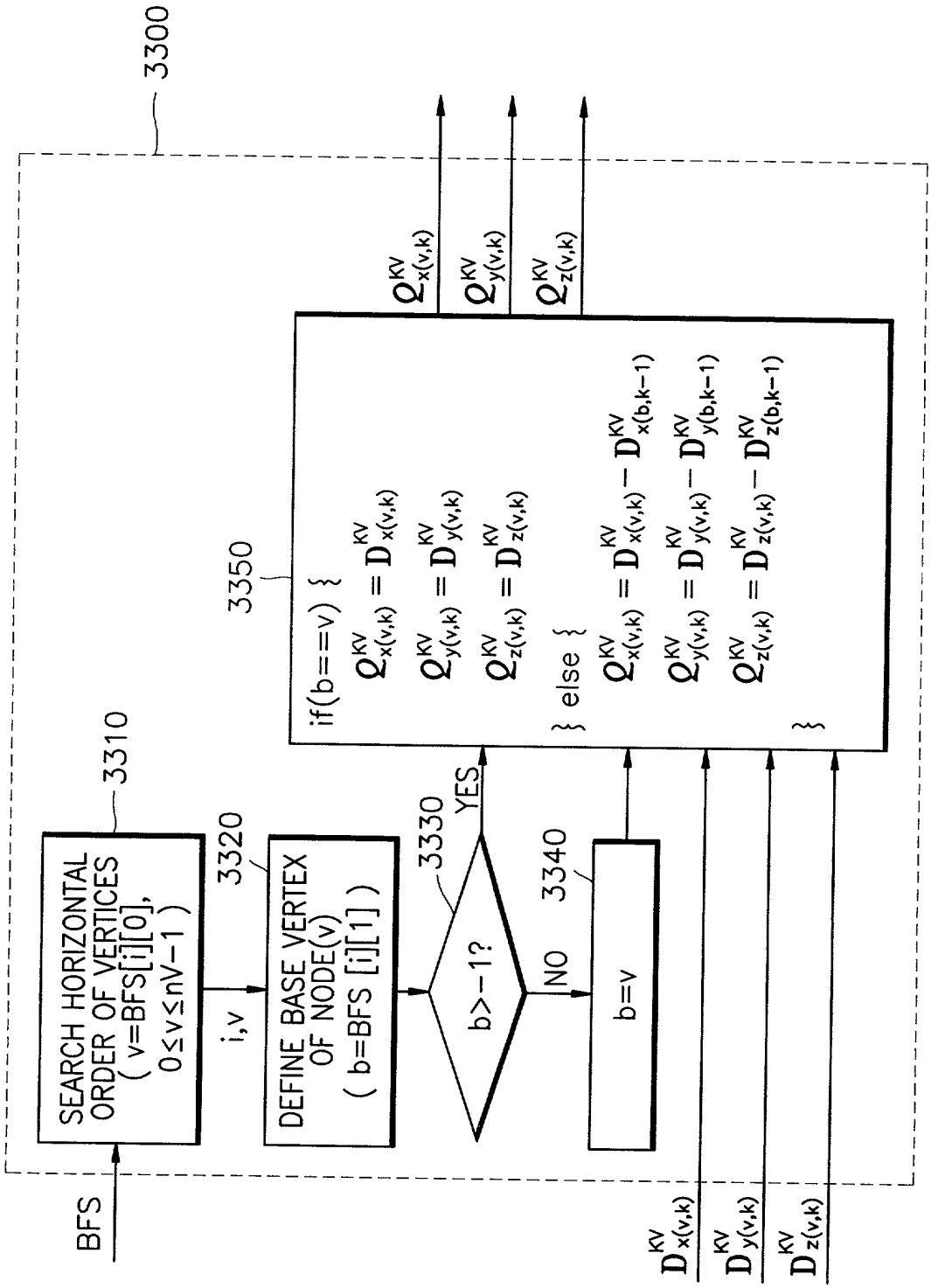

3300
BFS
SEARCH HORIZONTAL ORDER OF VERTICES (v=BFS[i][0], 0≤v≤nV−1)
3310
i,v
DEFINE BASE VERTEX OF NODE(v) (b=BFS [i][1])
3320
b>−1?
3330
YES
NO
b=v
3340
3350
if(b==v) {
$Q^{KV}_{x(v,k)} = D^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)} = D^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)} = D^{KV}_{z(v,k)}$
} else {
$Q^{KV}_{x(v,k)} = D^{KV}_{x(v,k)} - D^{KV}_{x(b,k-1)}$
$Q^{KV}_{y(v,k)} = D^{KV}_{y(v,k)} - D^{KV}_{y(b,k-1)}$
$Q^{KV}_{z(v,k)} = D^{KV}_{z(v,k)} - D^{KV}_{z(b,k-1)}$
}
$Q^{KV}_{x(v,k)}$
$Q^{KV}_{y(v,k)}$
$Q^{KV}_{z(v,k)}$
$D^{KV}_{x(v,k)}$
$D^{KV}_{y(v,k)}$
$D^{KV}_{z(v,k)}$

FIG. 16

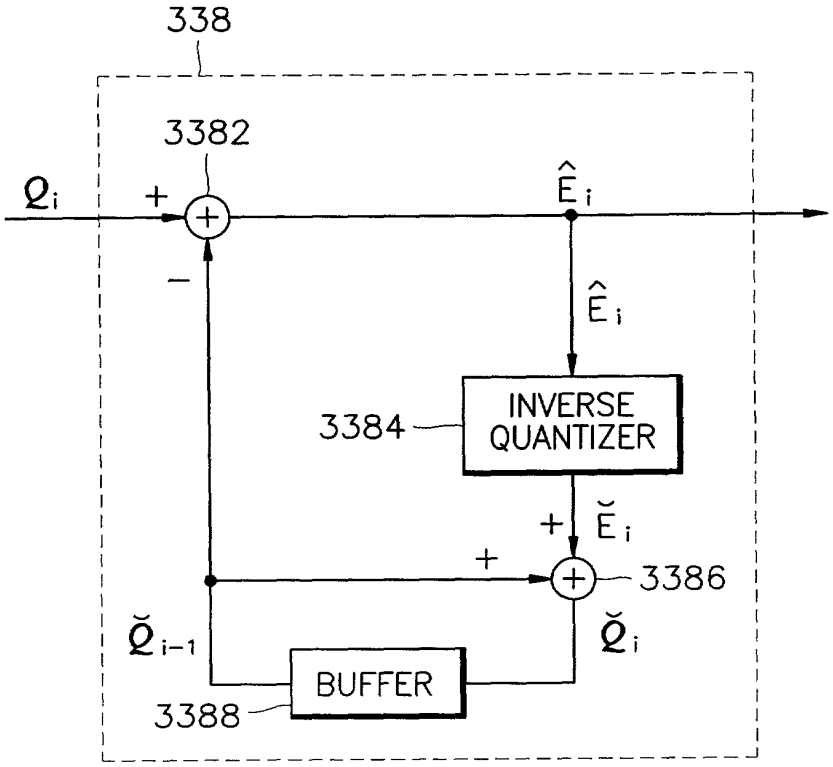

338
3382
Q_i
+
−
$\hat{E}_i$
$\hat{E}_i$
3384
INVERSE QUANTIZER
+
$\breve{E}_i$
+
3386
$\breve{Q}_{i-1}$
$\breve{Q}_i$
BUFFER
3388

FIG. 17

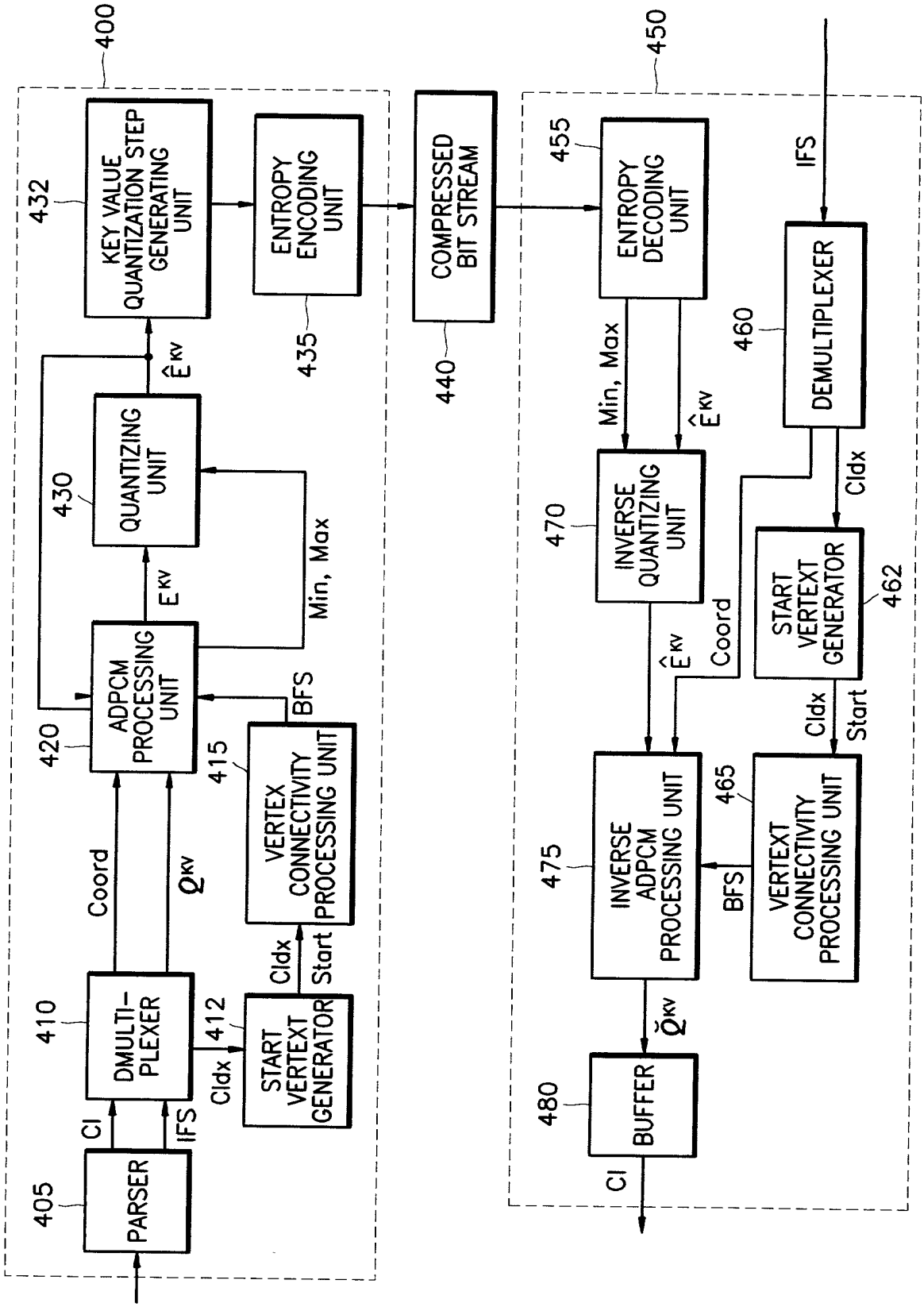

400
450
PARSER
405
DMULTI-PLEXER
410
START VERTEXT GENERATOR
412
VERTEX CONNECTIVITY PROCESSING UNIT
415
ADPCM PROCESSING UNIT
420
QUANTIZING UNIT
430
KEY VALUE QUANTIZATION STEP GENERATING UNIT
432
ENTROPY ENCODING UNIT
435
COMPRESSED BIT STREAM
440
ENTROPY DECODING UNIT
455
DEMULTIPLEXER
460
START VERTEXT GENERATOR
462
VERTEXT CONNECTIVITY PROCESSING UNIT
465
INVERSE ADPCM PROCESSING UNIT
475
INVERSE QUANTIZING UNIT
470
BUFFER
480
CI
IFS
Coord
Cldx
Start
BFS
Min, Max

FIG. 18

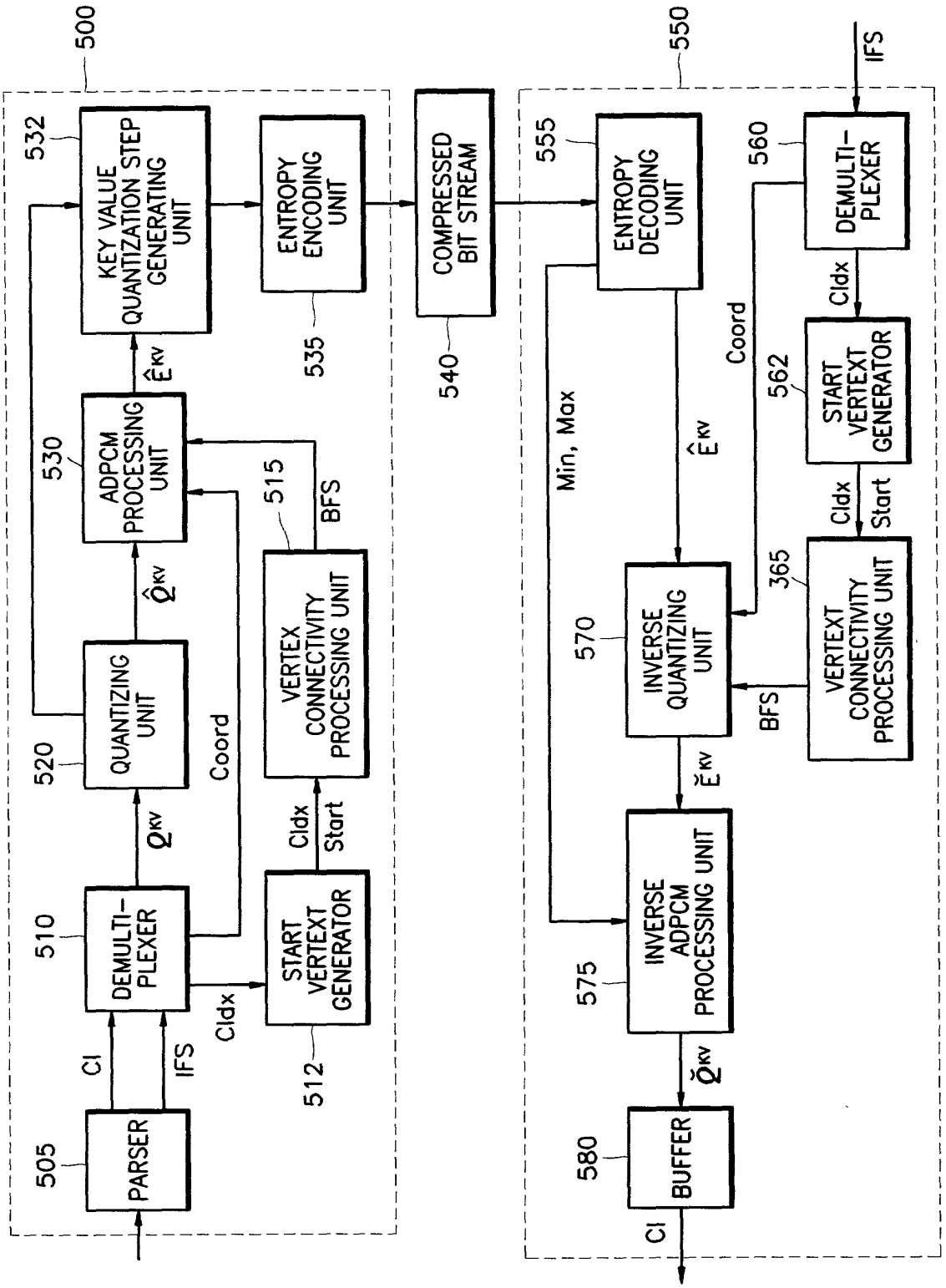

500
505
PARSER
510
DEMULTI-PLEXER
520
QUANTIZING UNIT
530
ADPCM PROCESSING UNIT
532
KEY VALUE QUANTIZATION STEP GENERATING UNIT
535
ENTROPY ENCODING UNIT
540
COMPRESSED BIT STREAM
512
START VERTEXT GENERATOR
515
VERTEX CONNECTIVITY PROCESSING UNIT
CI
IFS
Cidx
Start
BFS
Coord
Min, Max
Q^{KV}
$\hat{Q}^{KV}$
$\hat{E}^{KV}$
$\check{Q}^{KV}$
$\check{E}^{KV}$
550
555
ENTROPY DECODING UNIT
560
DEMULTI-PLEXER
562
START VERTEXT GENERATOR
565
VERTEXT CONNECTIVITY PROCESSING UNIT
570
INVERSE QUANTIZING UNIT
575
INVERSE ADPCM PROCESSING UNIT
580
BUFFER

FIG. 19

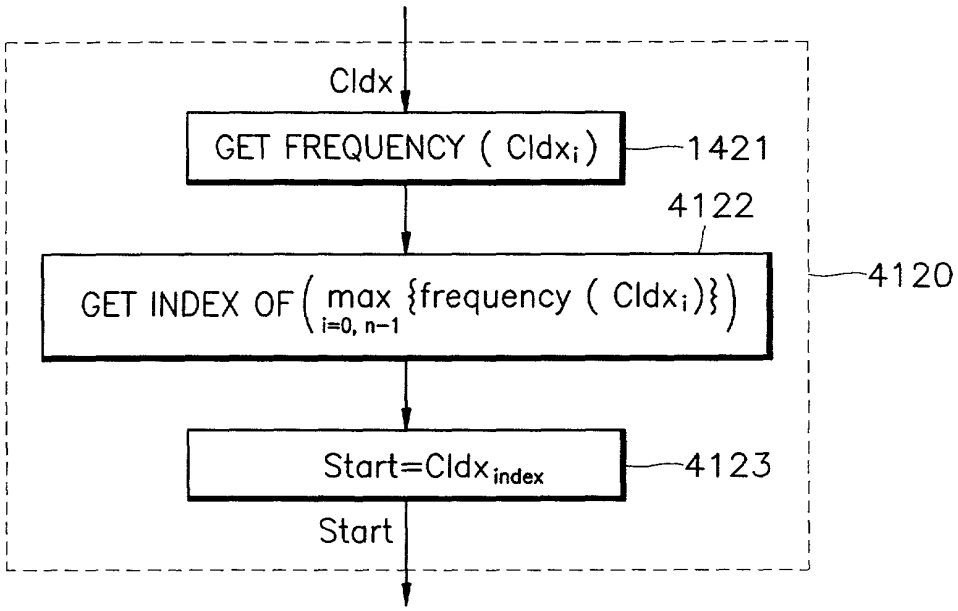

Cldx
GET FREQUENCY (Cldx$_i$)
1421
4122
GET INDEX OF (max {frequency (Cldx$_i$)})
i=0, n-1
4120
Start=Cldx$_{index}$
4123
Start

FIG. 20

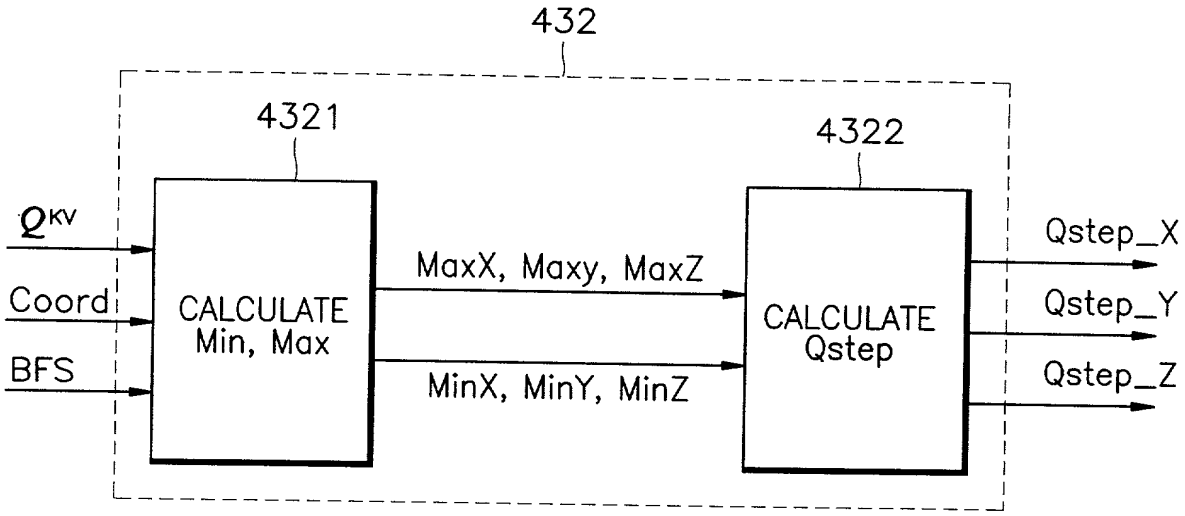

432
4321
4322
QKV
Coord
BFS
CALCULATE
Min, Max
MaxX, Maxy, MaxZ
MinX, MinY, MinZ
CALCULATE
Qstep
Qstep_X
Qstep_Y
Qstep_Z

FIG. 21

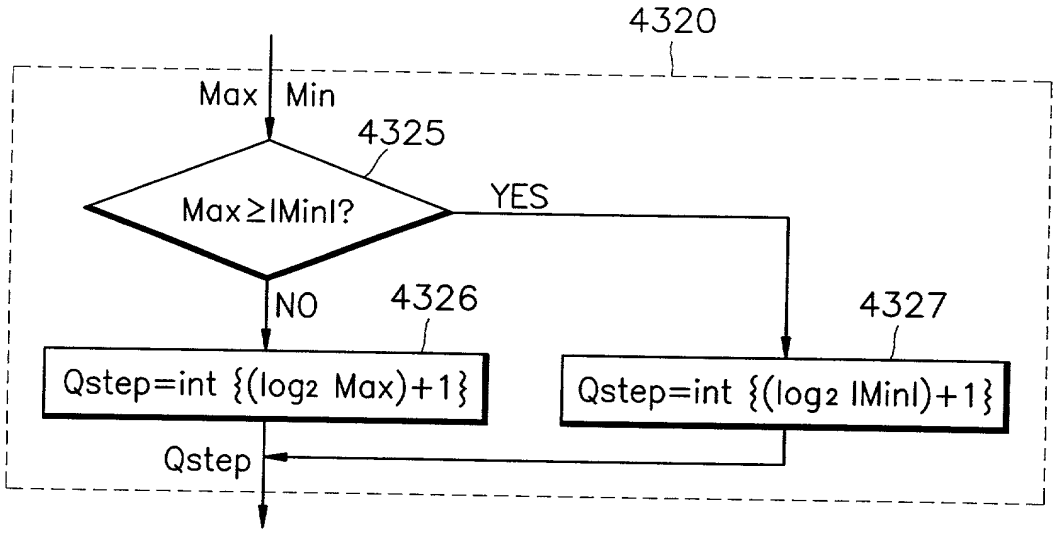
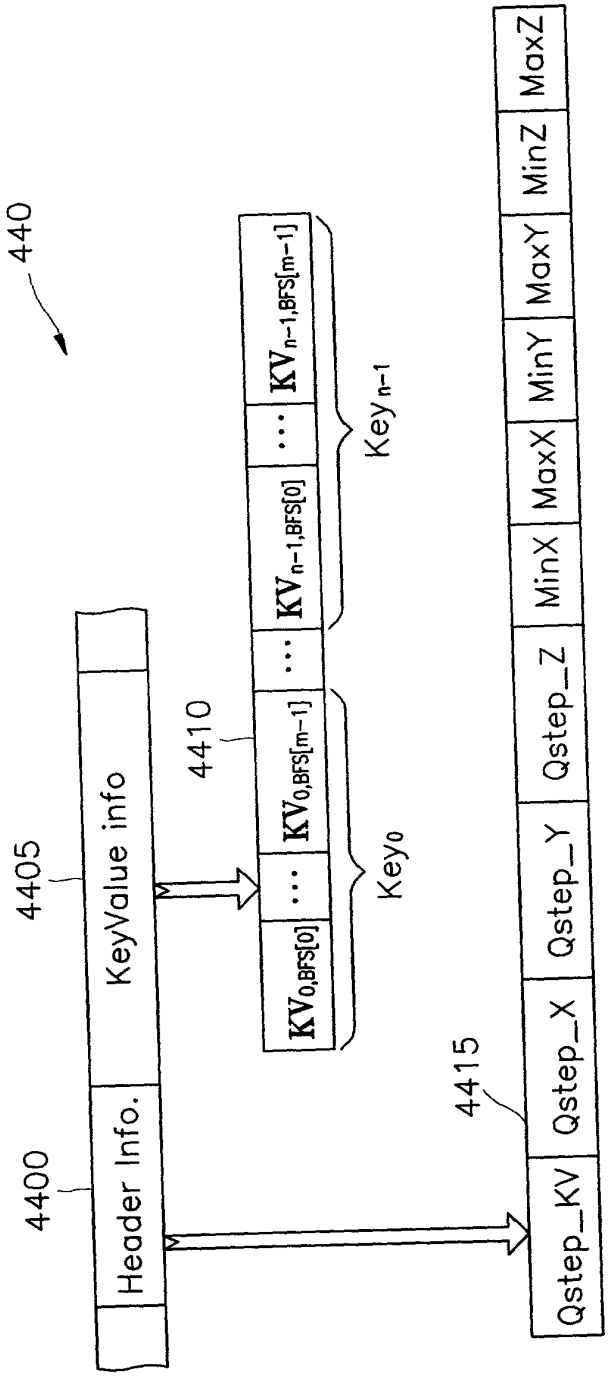

4320
Max
Min
4325
Max≥|Min|?
YES
NO
4326
4327
Qstep=int {(log2 Max)+1}
Qstep=int {(log2 |Min|)+1}
Qstep

FIG. 22


440
4400
Header Info.
4405
KeyValue info
4410
$KV_{0,BFS[0]}$
...
$KV_{0,BFS[m-1]}$
...
$KV_{n-1,BFS[0]}$
...
$KV_{n-1,BFS[m-1]}$
Key_0
Key_{n-1}
4415
Qstep_KV
Qstep_X
Qstep_Y
Qstep_Z
MinX
MaxX
MinY
MaxY
MinZ
MaxZ